

Soil Reaction

Define P^H and Soil P^H

P^H : P^H may be defined as the negative logarithm of hydrogen ion (H⁺) concentration in a solution.

Soil P^H : Soil P^H may be defined as the negative logarithm of hydrogen ion (H⁺) concentration in a soil solution. Soil P^H first proposed by Sorensen (1909) a Swedish chemist.

P^H is expressed as number (0-14) and H⁺ concentration is expressed in *gm-ion/L*.

$$P^H = -\log[H^+]$$

The suitable P^H range for maximum field crop production is 6.0-7.5. Soil P^H is an indicator of acidity & alkalinity of a soil solution.

$$P^H < 7 = \text{Acid soil}$$

$$P^H > 7 = \text{Alkaline soil}$$

$$P^H = 7 = \text{Neutral soil}$$

Forms of H⁺ ion in soil

There are 2 forms of H⁺ ion in soil-

- 1. Active form:** When H⁺ ion is present in soil.
- 2. Potential form:** When H⁺ is present in reserved condition as absorbed by soil colloids. e.g. clay, humus.

Grading of soil according to P^H Value

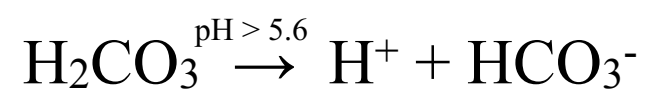
The P^H value, therefore represent the amount of free active acidity and not the total quantity of potential acidity. In other words, it represents the intensity of acidity of a solution. In this scale, the P^H values ranges from 0-14, where P^H = 0 represent the highest limit of active acidity and P^H =14 the highest degree of basicity. Neutrally represent P^H = 7. Therefore, P^H = 7 shows neutral reaction. When P^H is less than 7 the solution is acidic. when it is above 7, it is alkaline.

Therefore, the grading of soil according to P^H values are given below-

P ^H Value	Grade of soil
3.5 or below 3.5	Extreme acidic soil
3.5 - 4.0	Very strong acidic soil
4.0 - 5.0	Strong acidic soil
5 - 6	Moderate acidic soil
6 - 7	Slight acidic soil
7	Neutral soil
7 - 8	Slight alkaline soil
8 - 9	Moderate alkaline soil
9 - 10	Strong alkaline soil
10 - 10.5	Very strong alkaline soil
10.5 or more	Extreme alkaline soil

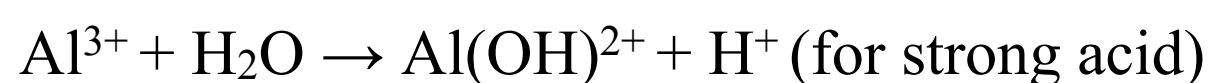
Causes of Soil Acidity

1. Leaching of basic cation by heavy rainfall: CO₂ dissolve in water to produce carbonic acid (H₂CO₃). These H₂CO₃ removes the basic cations (i.e. Mg⁺, Na⁺, Ca⁺, K⁺) from alkaline soil and form bi-carbonate which are soluble in water. These bi-carbonate are leach down due to heavy rainfall and causes soil acidity.



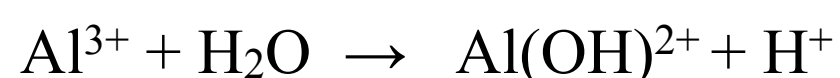
2. Acidic parent material: Some soils have developed from acidic parent material, so the soils are acidic soil. e.g. Acid rock (granite) → Acid soil.

3. Increase of acid cations (Al³⁺, Fe³⁺ & Mn⁴⁺): These ions on hydrolysis produce H⁺ ion in soils and thus causes soil acidity.



Similar reaction will be occur in case of Fe³⁺ and Mn⁴⁺. Al³⁺ and H⁺ are two acidic cations which are mainly responsible for soil acidic.

4. Alumino-silicate minerals: At low P^H values most of the Aluminium is present as the hydrate Aluminium ions (Al³⁺) which undergoes hydrolysis and release hydrogen (H⁺) ions in the soil solution that develop soil acidity.



5. Application of manures and fertilizers: Manures- by decomposition of different types of organic matter in soil produce different types of organic acid. e.g. pulmic acid. These organic acid produce H⁺ which can create soil acidity.



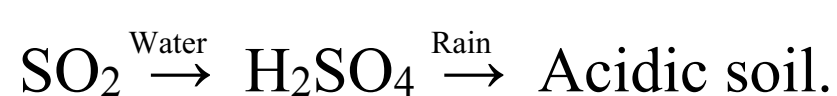
Fertilizer- Ammonium sulphate decrease P^H more than Urea. So, it is usually apply in tea garden.



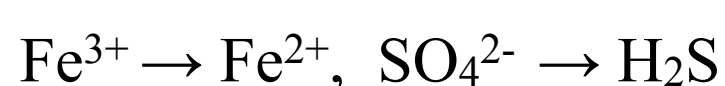
6. Carbon-di-oxide(CO₂): Root activity and metabolism may serve as source as CO₂ which dissolved in soil water and produce Carbonic acid (H₂CO₃). As a result, soil acidity occurs.



7. Acid rain: In industrial area SO₂ and NH₃ etc are present in high amount. These mix with rain water and come down to the earth and causes soil acidity.



8. Acid sulphate soil: Oxidized form of SO₄²⁻ and Fe³⁺ converted into reduced form when the land receive tidal flood. These reduced form react together to form FeS₂. This FeS₂ is Oxidized to Fe₂(SO₄)₃. As a result, P^H decreases and acidity of soil occur.





9. Nutrient Uptake: In rhizosphere cation and anion ratio 1:1 always same. If H^+ uptake increases then soil acidity increases i.e. soil pH decreases. When OH^- Uptake increases then soil alkalinity increases i.e. pH increases.

Problems of Soil Acidity

problems of soil acidity may divided 3 groups which are as follows-

1. Toxic effects.

- Acid toxicity.
- Toxicity of different nutrient.

2. Nutrient availability.

- * Non specific effects.
- * Specific effects.

→ Exchangeable base

→ Nutrient imbalances

3. Microbial activity.

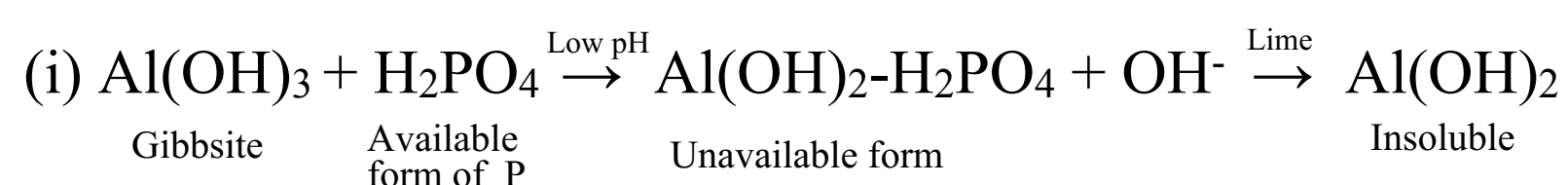
Problems

- pH lower.
- Micro nutrient and Mo is lower.
- Phosphorus fixation is not occurred.
- Decomposition rate minimized.
- Basic cation availability gone lower.
- In Acid Sulphate soil, Sulphate toxicity occurred.

Role of pH on Nutrient Availability

Availability of all nutrient depend on soil pH . Generally macro nutrients with Mo availability increase as soil pH increase. On the other hand, availability of micro nutrient except Mo decreases with the increases of soil pH . This is suitable pH for available of all nutrient is around 6.5 - 7.5.

P availability: These element (p) availability is maximum when soil pH range 6 -7.5. The availability of P in acid soils (low pH) is hamper due to formation of Fe, Al, Mn phosphate.

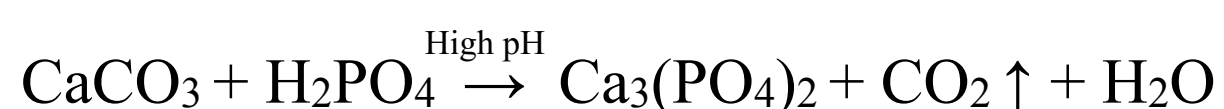


Same as (i) no equation

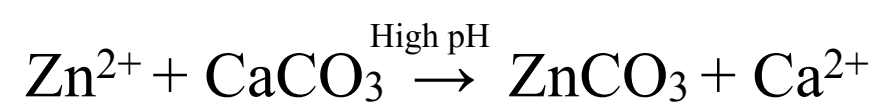
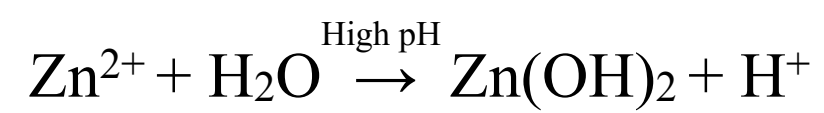


P deficiency is very likely in low pH . e.g. Modhupur.

(iii) P- fixation occurred in calcareous soil up to 8.5 pH and increases the availability of P.

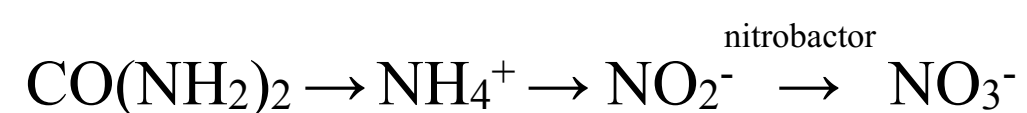


Zn availability: Zinc availability is low at high soil P^H due to the formation of insoluble $Zn(OH)_2$ or $ZnCO_3$.



Toxicity of Al, Fe and Mn: In strong acidic soil ($P^H < 5$) toxicity of Al, Fe and Mn may arise. They are more soluble in acidic condition and absorption is more, as a result toxicity arise.

Microbial activity: Generally bacteria are active in neutral and slightly alkaline soils while fungi are active in acidic soil. So, organic matter decomposition, N_2 -fixation and nitrification are tremendously reduce when soil P^H below 5.5.



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